CIF 23-5: Plasma-Based Elemental Analyzer for Crewed Transit and Planetary Habitation

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Activity Type: New Start

Prime Taxonomy: TX06.4.1 Sensors: Air, Water, Microbial, and Acoustic

Start TRL: 2 **End TRL:** 3

Executive Summary: As NASA continues to perform research on the ISS and move towards the Moon and Mars, it is important for astronauts to have a technology capable of determining the composition of solid, liquid, and gas samples. Currently, samples are transported back to Earth for analysis, which may impact results due to the time delay of samples waiting to be returned to Earth as well as potential sample contamination from re-entry, change in environment, and various personnel handling. Therefore, researchers at the Applied Chemistry Lab at KSC have developed a proof-of-concept "Plasma-Based Elemental Analyzer," which has the capability of testing solid, liquid, and gas samples for identification. Currently, the analysis is only qualitative, with quantitative identification left for future work. This technology is similar to ICP-OES, but differs in instrument size and sample preparation. Both technologies use plasma to ionize samples for light emission. The plasma elemental analyzer aims to be portable and lightweight, require only electrical power, and analyze solid, liquid, and gas samples. It does not use acid digestion or a nebulizer, requires less power than ICP-OES, and is able to operate with minimal to no usage of argon gas. Furthermore, the plasma elemental analyzer operates within low power constraints, which makes it feasible for usage on future missions with higher power constraints. The technology was tested at atmospheric pressure using mostly room air as the carrier gas for plasma production in the proof-of-concept study. The results showed the peak signals of the elements with an associated arbitrary signal intensity that allowed for qualitative identification. Solid samples that were tested included inedible biomass from the Golden Heirloom Cherry Tomato plant and Lunar Highlands Simulants (LHS-1). The liquid samples included elements of interest for the space crop production community. This work showed that a system smaller than the traditional ICP-OES equipment is able to be designed and implemented in future use cases, although it requires further development.